

The science output of the Lunar Laser Ranging Program (LLRP) to date has been based upon the analysis of the data from the five retro-reflector arrays currently on the Moon with the data collected primarily by four observatories. This LLRP has produced most of the best tests of General Relativity. The next generation retroreflectors, the Lunar Laser Ranging Array for the 21<sup>st</sup> Century (LLRRA-21) will consist of one large corner cube, which allows a much more precise determination of the time delay for the returning signal on Earth. The simulations to be presented here, addressing the Advanced Lunar Laser Ranging Program (ALLRP), will illustrate the impact on the accuracy obtained for the science parameters for the different deployment scenarios, the different package masses, the different pointing procedures, and different ground stations capabilities. The science impact will be assessed by addressing the improvement in various relativity parameters into the 2030 time frame. In particular, we will address the Strong Equivalence Principle, the Temporal Change of the Gravitational Constant, the Inverse Square Law (Yukawa parameter) and the Geodetic Precession and coordinates of the retroreflectors. The simulations for the next generation lunar retro-reflector deployed at the selected locations on the Moon used in conjunction with the Apollo and Lunokhod arrays will address the effects on the science accuracy of different values for the range measurement accuracy.